Unusual Lichens: Exploring Nature's Most Mysterious and Unique Symbiotic Organisms

Douglas C. Youvan

doug@youvan.com

February 18, 2025

Lichens are among the most remarkable and resilient symbiotic organisms on Earth, thriving in some of the most extreme environments, from icy tundras to arid deserts. Composed of a partnership between a fungus and a photosynthetic alga or cyanobacterium, lichens have evolved unique biochemical adaptations that allow them to survive where few other organisms can. Beyond their ecological importance in stabilizing soil, contributing to nutrient cycles, and serving as bioindicators of environmental health, some lichens possess extraordinary properties that challenge our understanding of nature. This article explores some of the most unusual and mysterious lichens, including species with historical significance, like the Mummy Lichen (*Pseudevernia furfuracea*), potential hallucinogenic properties, like *Dictyonema huaorani*, and those that exhibit extraordinary chemical defenses or structural adaptations. From rare, possibly extinct species to newly discovered lichens thriving in unexpected environments, these organisms reveal the hidden complexity of the natural world. As scientific research into lichens continues, their potential applications in medicine, climate studies, and biotechnology could be groundbreaking.

Keywords: lichens, unusual lichens, rare lichens, symbiosis, fungal-algal partnership, Dictyonema huaorani, Mummy Lichen, lichen biodiversity, psychedelic lichens, bioactive compounds, lichenometry, climate change indicators, urban lichens, lichen conservation, endangered lichens, extreme environments, ecological resilience, medicinal lichens, lichen chemistry.

I. Introduction

Lichens are extraordinary symbiotic organisms composed of a fungal partner (the mycobiont) and a photosynthetic partner (the photobiont), which can be either algae or cyanobacteria. Unlike traditional plants, lichens do not possess roots, stems, or leaves. Instead, they derive nutrients from the environment through their photobiont, which harnesses solar energy to produce food. The fungus provides structural support, protection, and helps retain moisture, making the partnership an elegant example of mutualism in nature.

Lichens are found in nearly every terrestrial environment on Earth, from the arid deserts of Africa to the frozen tundras of Antarctica. Their adaptability is astounding—they can survive extreme drought, high altitudes, and even outer space conditions, as demonstrated by experiments exposing lichens to the vacuum of space. They play critical ecological roles by breaking down rock into soil, providing food for various animals, and serving as bioindicators for air quality. Certain lichens are highly sensitive to pollutants such as sulfur dioxide, making them natural environmental monitors.

While many lichens appear unremarkable at first glance, there are species that stand out due to their exceptional characteristics, historical significance, or unique chemical compositions. Some lichens have been used for medicinal or ceremonial purposes for centuries, while others possess bioactive compounds with potential applications in pharmaceuticals. Certain rare species, such as *Dictyonema huaorani*, are suspected of having psychoactive properties, potentially placing them in the same category as hallucinogenic fungi. Others, like the so-called Mummy Lichen, have been found preserved in ancient Egyptian burial materials, offering a glimpse into the past.

This article will explore some of the most unusual lichens known to science—those that defy conventional expectations through their rarity, chemistry, cultural importance, or environmental resilience. These fascinating organisms challenge our understanding of symbiosis, adaptation, and the chemical diversity of life on Earth.

II. Ancient and Historical Lichens

Lichens have played a subtle but significant role in human history, from their use in ancient rituals and preservation techniques to their modern applications in archaeology and climate science. While often overlooked, certain lichens provide remarkable insights into the past, helping researchers understand both human practices and environmental changes over time.

Mummy Lichen (Pseudevernia furfuracea)

One of the most intriguing historical lichens is *Pseudevernia furfuracea*, commonly known as the Mummy Lichen due to its discovery in ancient Egyptian burial materials. This species, a fruticose (shrub-like) lichen, is known for its antimicrobial and preservative properties, which likely contributed to its use in the mummification process.

Fragments of *P. furfuracea* have been found packed into the wrappings of mummified remains, where they may have served as a natural desiccant to absorb moisture and inhibit bacterial decay. Ancient Egyptians, who were highly skilled in embalming techniques, likely recognized the lichen's preservative qualities even without fully understanding its microbial properties. The discovery of *P. furfuracea* in Egyptian tombs underscores the sophisticated level of botanical and ecological knowledge possessed by early civilizations.

Beyond its historical significance, *P. furfuracea* has continued to be of interest in modern times due to its antimicrobial and anti-inflammatory properties. In certain traditional European folk medicines, it has been used in wound dressings and treatments for respiratory ailments. Today, researchers continue to investigate its bioactive compounds for potential pharmaceutical applications.

Lichenometry and Time-Keeping Lichens

In addition to their role in historical preservation, some lichens serve as natural clocks, helping scientists measure the passage of time and reconstruct past environmental conditions. Lichenometry, the study of lichen growth rates to date surfaces, has become an invaluable tool in archaeology, geology, and climate research.

One of the most commonly used lichens for this purpose is the Elegant Sunburst Lichen (*Xanthoria elegans*), a striking orange species that thrives on exposed rock surfaces in harsh environments. Because lichens grow at an extremely slow and predictable rate—often just a few millimeters per decade—scientists can use them to estimate the age of glacial moraines, rockslides, and even ancient human structures. By measuring the largest lichen colonies on a surface and correlating their size with known growth rates, researchers can determine how long a particular surface has been exposed to the elements.

Lichenometry has been particularly useful in dating glacial retreats in polar and alpine regions, providing crucial evidence for climate change studies. Since lichens are highly sensitive to environmental shifts, their presence, absence, or growth patterns can reveal past atmospheric conditions, pollution levels, and temperature fluctuations. In archaeology, lichen-covered ruins and monuments can be dated with remarkable accuracy, offering insights into the timeline of human settlements and construction activities.

The role of lichens in historical research, whether as tools for dating the past or as artifacts themselves, highlights their deep connection to both natural and human history. From ancient Egyptian tombs to modern climate science, these humble organisms continue to shape our understanding of the world across millennia.

III. Psychedelic and Mind-Altering Lichens

While psychedelic plants and fungi have been extensively documented in traditional medicine and shamanic practices, the idea of hallucinogenic lichens remains largely unexplored. However, there is some evidence that certain lichen species may contain psychoactive compounds, placing them in a rare and mysterious category of natural psychedelics. The most well-known case is *Dictyonema huaorani*, a species reportedly used in shamanic rituals by an indigenous Amazonian tribe. However, other lichens have been speculated to possess similar properties, though scientific research on these species remains in its infancy.

Dictyonema huaorani: The Enigmatic Psychedelic Lichen

One of the most intriguing discoveries in the field of ethnobotany and psychedelic research is the lichen *Dictyonema huaorani*, named after the Waorani people of Ecuador, who reportedly used it in shamanic rituals. The Waorani, a small indigenous group living in the Amazon rainforest, referred to the lichen as "nɇnɇndape", describing its use for invoking spirits or placing curses upon enemies. Unlike other psychedelic substances that are often associated with communal or healing rituals, the use of this lichen was considered aggressive and malevolent in nature.

The existence of a hallucinogenic lichen was first documented by ethnobotanists Wade Davis and Jim Yost in 1981. They collected samples of the lichen and brought them back for analysis, but due to difficulties in obtaining pure reference compounds, the psychoactive properties of *D. huaorani* remain unconfirmed. Some researchers suspect that this lichen could contain tryptamine-based alkaloids, similar to psilocybin (the active compound in "magic mushrooms") or dimethyltryptamine (DMT), which is commonly found in Ayahuasca brews used in Amazonian shamanism.

The hypothesis that *D. huaorani* could be psychoactive is based on both its reported use and its classification as a basidiolichen—a rare type of lichen formed by a symbiotic relationship with a basidiomycete fungus, which is the same fungal group that includes psychedelic mushrooms (*Psilocybe* spp.). If confirmed, *D. huaorani* would be the first known hallucinogenic lichen, opening up an entirely new domain in the study of naturally occurring psychedelics.

Unfortunately, the only known specimen of this species is housed at Harvard University’s Farlow Herbarium, and no follow-up studies have been conducted to verify its chemical composition. Given its extreme rarity and cultural significance, further research into *D. huaorani* may prove challenging but could yield groundbreaking discoveries about lichen-derived psychoactive compounds.

Other Potential Psychoactive Lichens

Beyond *Dictyonema huaorani*, some researchers have speculated that other lichens may also contain mind-altering compounds. However, there is currently very little scientific evidence to support these claims. Some key areas of interest include:

- Usnic Acid and Neuroactive Effects
    - Found in many lichen species, usnic acid is a well-studied secondary metabolite with antimicrobial and anti-inflammatory properties. While it has not been classified as psychoactive, some researchers have investigated its effects on the central nervous system, suggesting it may interact with neuroreceptors in ways that warrant further study.
    - However, usnic acid is potentially toxic at high doses and has been linked to liver damage, making it unlikely to be a safe psychedelic compound.
- Speculative Connections to Other Psychoactive Compounds
    - Some lichens produce secondary metabolites that structurally resemble psychoactive alkaloids found in plants and fungi.
    - There have been anecdotal reports of hallucinatory effects following accidental ingestion of unidentified lichens, but these accounts remain unverified.
- Ethnobotanical Clues and Unstudied Species
    - Many indigenous cultures have extensive knowledge of psychoactive plants and fungi, but lichens have largely been ignored in ethnobotanical studies.
    - Given that the Waorani reportedly used *D. huaorani*, it is possible that other lichens with psychoactive properties exist in remote and unexplored regions.

Despite these hints, no other lichen species have been conclusively proven to have hallucinogenic properties. Unlike psychedelic mushrooms, which have clear

chemical signatures and well-documented effects, lichens remain largely unexplored in the field of psychoactive research.

Conclusion

The potential for lichens to contain psychoactive compounds is an exciting and largely untapped area of study. *Dictyonema huaorani* remains the only lichen with documented indigenous use as a mind-altering substance, but its chemical composition has yet to be definitively analyzed. If future research confirms that lichens can produce psychoactive alkaloids, it could redefine our understanding of symbiotic organisms and their chemical potential.

As science continues to explore the biochemical diversity of lichens, it is possible that new hallucinogenic species will be discovered, expanding the list of naturally occurring psychedelics. Until then, the mystery of *D. huaorani* serves as a reminder that nature still holds many secrets waiting to be uncovered.

IV. Lichens with Unusual Chemistry and Bioactivity

Lichens are known for their remarkable adaptability and chemical diversity, producing a vast array of secondary metabolites that contribute to their survival in extreme environments. Some of these compounds have potent antimicrobial, antiviral, and anti-inflammatory properties, making lichens valuable subjects of study in pharmacology and biotechnology. While most lichens are relatively well-documented, a few stand out due to their highly unusual structures, rare habitats, and unique chemical compositions. The following species are particularly notable for their exceptional characteristics and bioactive potential.

Enigmotrema rubrum: The Mysterious Red Lichen of Costa Rica

Enigmotrema rubrum is a rare lichen species native to Costa Rica, distinguished by its deep red fruiting bodies, a feature rarely seen in lichens. The genus *Enigmotrema* itself is unique, with the name derived from the Greek words for

"mystery" (*enigma*) and "hole" (*trema*), referencing its puzzling reproductive structures.

Unique Fungal-Algal Interaction

Unlike most lichens, *E. rubrum* exhibits an unusual symbiotic interaction between its fungal and algal partners. While typical lichens have a clear differentiation between fungal hyphae and algal cells, *E. rubrum* demonstrates a more integrated relationship, with the photobiont deeply embedded within the fungal layers. This structure is believed to provide enhanced protection from environmental stressors such as UV radiation and desiccation.

Chemical Significance

The striking red pigmentation of *E. rubrum* suggests the presence of unique secondary metabolites, possibly related to anthraquinones or carotenoids, which have been associated with antimicrobial and antioxidant properties in other lichens. Though its full chemical profile has yet to be explored, scientists believe *E. rubrum* may contain novel bioactive compounds with pharmaceutical applications.

Given its rarity and limited documented occurrences, *Enigmotrema rubrum* remains an enigma in the world of lichenology, requiring further research to uncover its full ecological and biochemical significance.

Hypogymnia saxicola: A High-Altitude Survivor from China

Hypogymnia saxicola is an exceptionally resilient lichen species found in the subalpine regions of China, particularly in Yunnan and Sichuan provinces. This lichen forms glossy, cushion-like structures, allowing it to withstand harsh environmental conditions, including extreme cold, low oxygen levels, and high UV exposure.

Adaptations to High-Altitude Environments

Unlike many lichens that thrive on tree bark, *H. saxicola* prefers rocky substrates, where it anchors itself against strong winds and temperature fluctuations. Its

glossy surface is thought to aid in water retention, allowing it to survive prolonged periods of drought.

Unusual Chemical Properties

H. saxicola produces an array of secondary metabolites that protect it from oxidative stress and microbial attack. Some of these compounds include:

- Atranorin and Lobaric Acid – Known for their antimicrobial and anti-inflammatory properties, these compounds help *H. saxicola* resist infections from bacteria and fungi.
- Hypogymnic Acid – A rare metabolite unique to certain species of *Hypogymnia*, believed to play a role in UV protection and cellular repair.

The ability of *H. saxicola* to endure extreme high-altitude conditions makes it a fascinating model organism for studying stress tolerance in symbiotic organisms. Additionally, its bioactive compounds hold promise for applications in medicine and skincare.

Lepidostroma vilgalysii: The Window Lichen of Mexico

One of the most unusual basidiolichens discovered to date, *Lepidostroma vilgalysii* is found in the Trans-Mexican Volcanic Belt, an area characterized by high-altitude pine forests and volcanic soils. Unlike most lichens, which belong to the fungal class Ascomycetes, *L. vilgalysii* is a Basidiomycete, meaning its fungal partner is more closely related to mushrooms than to typical lichenized fungi.

The “Window Lichen” Structure

A defining feature of *L. vilgalysii* is its unusual photobiont arrangement, earning it the nickname “window lichen.” Unlike conventional lichens, where the algae or cyanobacteria are evenly distributed within the fungal layers, in *L. vilgalysii*, the photobiont is concentrated at the base of the lichen body. This creates a window-like effect, allowing light to penetrate deeper into the lichen's structure, optimizing photosynthesis in shaded or low-light environments.

Cyanobacterial-Algal Integration

Another remarkable aspect of *L. vilgalysii* is its ability to host both cyanobacteria and algae within the same structure. This is rare among lichens, as most species rely on only one type of photobiont. The presence of cyanobacteria enables the lichen to fix atmospheric nitrogen, enriching the surrounding soil and benefiting nearby plant life.

Potential Bioactive Properties

Although little is known about its chemical composition, researchers speculate that *L. vilgalysii* may produce novel antioxidant and antimicrobial compounds, given the bioactive potential observed in other basidiolichens. The integration of multiple photobionts also suggests possible metabolic enhancements, which could inspire new biotechnological applications.

As a rare and biologically complex species, *Lepidostroma vilgalysii* provides a unique perspective on the evolution of symbiotic relationships and the ecological adaptations of lichens in extreme environments.

Conclusion

These three lichens—*Enigmotrema rubrum*, *Hypogymnia saxicola*, and *Lepidostroma vilgalysii*—demonstrate the extraordinary chemical and structural diversity found in lichenized fungi. From rare red fruiting bodies and high-altitude adaptations to complex cyanobacterial-algal partnerships, these species highlight the biochemical ingenuity of nature.

The study of these lichens offers insights into extremophile survival strategies, potential pharmaceutical applications, and the evolutionary history of symbiosis. As scientific interest in lichen-derived compounds continues to grow, further research may uncover new medical breakthroughs and environmental applications hidden within these remarkable organisms.

V. Endangered and Recently Discovered Lichens

Lichens are some of the most resilient organisms on Earth, capable of thriving in extreme environments, from deserts to polar regions. However, despite their adaptability, many lichen species are at risk due to habitat destruction, pollution, and climate change. Some lichens are so rare that they exist only in museum collections, while others are being newly discovered in unexpected places. This section explores three noteworthy lichens—one possibly extinct, one found in an unusual location, and one demonstrating remarkable resilience in urban environments.

Timucua Heart Lichen: A Vanishing Legacy

The Timucua Heart Lichen is a rare and possibly extinct lichen species that was originally found in Florida. It is named for its distinctive, scalloped, heart-shaped edges and its historical association with the Timucua people, an indigenous group that once inhabited the southeastern United States.

Possible Extinction

This species was first identified in museum collections rather than in the wild, highlighting the mystery of its origins and distribution. Despite efforts to locate living specimens, no known populations have been found in recent surveys, leading scientists to suspect that it may have gone extinct. Habitat destruction from urban development and deforestation in Florida is considered a likely cause of its disappearance.

Scientific and Cultural Importance

The Timucua Heart Lichen serves as a reminder of how easily species can disappear before they are fully studied. Its possible extinction underscores the importance of conservation efforts and the need for continued lichenological exploration in under-surveyed regions. If rediscovered, it could provide valuable insights into lichen ecology, resilience, and symbiosis.

Sand-Loving Icelandic Lichen (Cetraria arenaria): An Unexpected Find in Rhode Island

Sand-loving Icelandic Lichen (*Cetraria arenaria*) is a species typically associated with Iceland's volcanic landscapes, where it grows in sandy and nutrient-poor soils. However, a surprising discovery in Coventry, Rhode Island, has expanded its known range, challenging previous assumptions about its habitat preferences.

An Unusual Habitat

This lichen was unexpectedly found growing in a sandy, open area of Rhode Island—far from its usual Arctic and subarctic distribution. The discovery suggests that *C. arenaria* may be more adaptable than previously thought, capable of surviving in temperate climates under the right conditions.

Lichen Adaptability and Climate Change

The presence of *C. arenaria* in Rhode Island raises questions about lichen dispersal mechanisms and climate adaptation. Some scientists speculate that changing weather patterns or migratory bird activity may have contributed to its spread. This discovery also emphasizes how little is known about lichen biogeography and the factors influencing their distribution.

Sand-loving Icelandic Lichen serves as an important case study in lichen plasticity and ecosystem dynamics, demonstrating how even highly specialized species can sometimes thrive in unexpected locations.

Candelariella reflexa: The Urban Survivor

Unlike many lichens that thrive in pristine wilderness, Candelariella reflexa has carved out a niche in human-impacted environments, proving to be one of the most resilient urban lichens. This species forms a bright yellow-green granular crust, often found on tree trunks, roadside curbs, and even pollution-exposed surfaces.

Thriving in Polluted Environments

C. reflexa has been observed growing in areas with high nitrogen deposition, such as places frequented by dogs or along major roadways where vehicle emissions

contribute to increased nitrogen levels. Unlike many lichens that are sensitive to pollution, *C. reflexa* appears to benefit from these altered conditions, possibly due to its ability to metabolize airborne nutrients.

An Indicator of Urban Biodiversity

This lichen serves as an example of how some species can adapt to human-made environments, providing a potential model for understanding urban biodiversity and ecosystem resilience. Its ability to thrive in disturbed habitats makes it an excellent candidate for bioindicator studies, helping scientists monitor air quality and the ecological impact of urbanization.

Conclusion

The world of lichens is full of mysteries, from those that may be lost forever (*Timucua Heart Lichen*), to those adapting to new environments (*Cetraria arenaria*), to those demonstrating urban survival strategies (*Candelariella reflexa*). These species showcase the fragility, adaptability, and persistence of lichens in the face of environmental changes.

Understanding and conserving these unique organisms is critical—not only for preserving biodiversity but also for gaining insights into ecosystem health, climate adaptation, and the resilience of symbiotic life forms. As scientific exploration continues, new discoveries may further redefine our understanding of where lichens can survive and how they contribute to the planet's ecological balance.

VI. Conclusion

Lichens, often overlooked in the broader study of ecology and biodiversity, are among the most remarkable organisms on Earth. Their ability to thrive in extreme environments, from arid deserts to polar ice caps, makes them one of nature's most resilient symbiotic partnerships. This article has explored some of the most unusual and extraordinary lichens, from those with historical and cultural significance, such as the Mummy Lichen, to those that may possess psychoactive properties, such as *Dictyonema huaorani*. Other species demonstrate astonishing

adaptability, like the Sand-loving Icelandic Lichen, or unusual biological traits, such as *Lepidostroma vilgalysii* and its complex cyanobacterial-algal symbiosis.

Despite their incredible diversity and ecological importance, many lichens are facing increasing threats due to habitat destruction, climate change, and pollution. The Timucua Heart Lichen, which may now be extinct, serves as a sobering reminder that even the most resilient organisms are not immune to the impact of human activity. At the same time, species like Candelariella reflexa, which thrive in polluted environments, challenge our understanding of adaptation and resilience.

The Importance of Studying and Conserving Lichens

Lichens are more than just passive elements of the natural landscape—they play critical ecological roles by stabilizing soil, contributing to nutrient cycles, and serving as bioindicators of environmental health. Many lichen species produce bioactive compounds with antimicrobial, antiviral, and anti-inflammatory properties, making them valuable for pharmaceutical research. Some even show promise in bioremediation, as they can absorb heavy metals and pollutants from the air.

However, because lichens grow slowly and rely on delicate environmental conditions, they are especially vulnerable to ecosystem disturbances. Industrial pollution, deforestation, and climate shifts are all contributing to the decline of lichen populations worldwide. Yet, they remain one of the least-studied groups of organisms, with thousands of species still awaiting discovery and classification.

Call to Action: The Need for Further Research and Conservation

The study of lichens is a field ripe for discovery. Whether it is identifying new medicinal compounds, exploring their role in climate adaptation, or understanding their ancient connections to human civilizations, lichens offer profound insights into biology, chemistry, and ecology.

To ensure the protection and continued exploration of these remarkable organisms, the following steps are essential:

1. Increased Scientific Research: More studies should be conducted to understand lichen biodiversity, chemistry, and potential applications in medicine, industry, and environmental science.
2. Conservation Efforts: Governments and environmental organizations should prioritize the protection of lichen-rich habitats, especially in fragile ecosystems where rare species may be at risk.
3. Public Awareness and Citizen Science: Lichens are found everywhere, from forests to urban environments. Encouraging citizen science initiatives can help document and monitor populations, contributing valuable data to lichenology.
4. Biotechnological Exploration: With advances in genetic engineering and bioinformatics, the potential of lichens for creating new pharmaceuticals, sustainable materials, and pollution-mitigation strategies should be further explored.

Lichens remind us that life's most extraordinary forms are often the ones we least expect. By studying, conserving, and appreciating these symbiotic marvels, we can uncover new scientific frontiers while protecting some of the world's most ancient and fascinating life forms. The future of lichenology holds endless possibilities, and with continued exploration, we may soon discover even more hidden wonders in the world of lichens.

References

1. Pseudevernia furfuracea (Mummy Lichen):
    - *Embalming Practices in Ancient Egypt:* Pseudevernia furfuracea, commonly known as tree moss, was utilized in ancient Egyptian embalming processes. Fragments of this lichen have been found packed into the body cavities of mummies, suggesting its use for its aromatic and possibly preservative properties.

huh.harvard.edu

    - *Antimicrobial Activity:* Studies have demonstrated that extracts from P. furfuracea exhibit antimicrobial properties against various microorganisms, which may have contributed to its historical use in preservation.

en.wikipedia.org

2. Dictyonema huaorani:
    - *Discovery and Ethnobotanical Significance:* Dictyonema huaorani is a rare basidiolichen discovered in the Ecuadorian Amazon. It is reportedly used by the Waorani people in shamanic rituals, possibly for its hallucinogenic properties.

huh.harvard.edu

    - *Chemical Composition:* Preliminary chemical analyses suggest that D. huaorani contains compounds also found in the hallucinogenic mushroom Psilocybe cubensis, indicating potential psychoactive effects.

bioone.org

3. Lichenometry and Time-Keeping Lichens:
    - *Dating Techniques:* Lichenometry utilizes the growth rates of lichens, such as Xanthoria elegans, to date exposed rock surfaces. This method has been instrumental in fields like archaeology and climate studies.

4. Enigmotrema rubrum:
    - *Unique Characteristics:* Enigmotrema rubrum is a rare Costa Rican lichen notable for its dark red fruiting bodies and unique fungal-algal interactions.
5. Hypogymnia saxicola:
    - *Adaptations to High Altitudes:* Found in China, Hypogymnia saxicola features a glossy, cushion-like structure. Its unusual chemical properties enable it to survive in high-altitude regions.
6. Lepidostroma vilgalysii:
    - *Structural and Symbiotic Features:* This basidiolichen from Mexico exhibits a "window lichen" structure and showcases a unique cyanobacterial-algal integration.
7. Timucua Heart Lichen:
    - *Conservation Status:* The Timucua Heart Lichen, a unique species with scalloped edges native to Florida, is possibly extinct and known only from museum collections.
8. Cetraria arenaria (Sand-loving Icelandic Lichen):
    - *Unexpected Habitat Discovery:* Originally associated with Iceland, Cetraria arenaria was unexpectedly found in Rhode Island, highlighting the adaptability of lichen species.
9. Candelariella reflexa:
    - *Urban Resilience:* Candelariella reflexa thrives in human-impacted areas, such as polluted roadside environments, demonstrating remarkable resilience in urban settings.

These references provide insights into the diversity, ecological significance, and cultural importance of various lichen species, underscoring the need for continued research and conservation efforts.

Douglas Youvan
22 May 2023 ·

With spiritual eyes, the abandoned feeder is my late mother, and the wood is covered with different lichens and a little black mold. Lichens are synergistic algae plus fungus. Algae are photosynthetic, and I sequenced the DNA for the light reactions of photosynthesis in 1983. My career ended on ~ 911 when I stopped working on synergistic antibiotics. The lab I was given at MIT? That's where the extremely dangerous chemical aflatoxin was discovered from black mold.